

Brain Stem Control of Motor Function and the Vestibualr System

1- Mention the major functions of the brain stem?

. Control of posture (body position) and equilibrium*

. Control of eye movements*

. Control of many stereotyped movements of the body *

Stereotyped movement: هي الحركات النمطية المتكررة متل حركة ال Eye blinking

. It is a way station for commands from higher centers*

Such as the corticospinal tract and extrapyramidal tract from the high brain center toward the spinal cord must pass through the brain stem ,and the ascending tract from the sensory receptors toward the high brain center also pass the brain stem , so the brain stem is a an important station for upward and downward signals

*Contains control centers in the medulla for CVS, respiratory and GIT functions

2-What is the role of brain stem in supporting the body against gravity ?

By controlling the antigravity muscles

3- What are the responsible structures?

The pontine reticular nuclei and the medullary reticular nuclei

4-How they work together?

-The pontine reticular nuclei excite the antigravity muscles (extension)

-The medullary reticular nuclei relax the antigravity muscles(relaxation)

*the antigravity muscles receive two signals at the same moment one excitatory signals from the pontaine reticular nuclei and another inhibitory signal from the medullary reticular nuclei. If a person is laying down and wants to standup signals from the pontine reticular nuclei (excitatory signals) will be stronger than signals from the medullary reticular nuclei (inhibitory signals), and if a person is standing and wants to lay down signals from the medullary reticular nuclei will be stronger

5-Are there input from the higher centers?

Yes, the pontine reticular nuclei receive input from the cerebellum and vestibular nuclei (pons) and the medullary reticular nuclei receive input from the cortex and midbrain.

6-What is the benefit of the counterbalance between pontine and medullary structures?

To prevent the powerful overextension of antigravity muscles.

7-overextension occurs if the medullary reticular nuclei function is disturbed? Why?

Because signals from the medullary nuclei counterbalance signals from the potine nuclei and this prevent the overextension .but in case the medullary nuclei function

is disturbed and no signals are sending then pontine nuclei will over excite the antigravity muscles and lead to over extension.

3-Which parts of the vestibular apparatus concerned with equilibrium?

The semicircular canals, the utricle, and the saccule are all integral parts of the equilibrium mechanism.

4-Name the receptors of the utricle, saccule and semicircular canals?

The sensory organ inside the utricle and saccule is the “macula #

The sensory organ inside the semicircular canals are the crista ampullaris#

5-The above receptors have almost the same components but differ in the presence of statoconia and endolymph .What is the function of these structures?

The endolymph and statoconia force the hair cilia in the gelatinous layer to bend toward the gravity direction

Example *if you bend your head to the right direction, statoconia and endolymph will move in that direction and force the hair cilia to bend to the right.

6- How the hair cells can be excited?

*When cilia bend in the direction of the kinocilium, these channels open causing inward flow of positive ions and cell membrane depolarization

*When cilia bend in the opposite direction, the channels close causing cell membrane hyper polarization

If there is no excitation hair cells sends signals at static rate.

7-Explain the steps that lead to detection of head orientation in space (the static equilibrium)?

When the head bends in one direction, the heavy statoconia in the gelatinous material move in that direction following the pull of gravity

This cause bending of the hair cells and change in signal transmission to the vestibular nerve fibers

The signals from different hair cells apprise the brain about the head orientation in space

- اذا قمت مثلا بتحريك رأسك لجهة اليمين ال hair cells الموجودة في ال macula في الاذن اليمنى تتحرك في اتجاه ال kinocilium وبترسل depolarization signals
- بينما ال hair cell الموجودة في ال macula في الاذن اليسرى تتحرك في اتجاه معاكس لل kinocilium وبترسل hyperpolarization signals
- ولكن الإشارة المرسلة من الاذن اليمنى اقوى من الإشارة المرسلة من الاذن اليسرى وهكذا الدماغ سيقوم بتجميع الاشارتين ويحدد ان الحركة كانت لجهة اليمين . هذا يعني ان الدماغ يقوم باستلام اشارتين متعاكستين ولكن الإشارة الأقوى هي التي تساعد الدماغ في تحديد اتجاه حركة الرأس

8-Explain the steps that lead to detection of head linear acceleration. And why the feeling of

disequilibrium disappear when the person continue his running with one speed?

When the body suddenly accelerates forward, the statoconia fall backward with the hair cell cilia due to inertia.

Signal transmission increase giving a feeling of dysequilibrium (falling backward)

This automatically causes the person to lean forward , until the statoconia is shifted anteriorly exactly equals the backward fall , and signals decrease back to normal , and no farther forward leaning occur .When the person continue his running with one speed, the feeling of disequilibrium will disappear because Signaling occurs only at initial acceleration or at stopping and not at the constant speed .

9-explain the steps that lead to detection of head angular acceleration?

All the steps found in details in the PowerPoint.

10-How the predictive function of semicircular canals occurs? And why we call it predictive ?

If a person is running forward rapidly and then suddenly begins to turn to one side, the semicircular ducts will detect head turning, and this inform the higher centers that the person will fall off balance within the next fraction of a second unless some correction is made . if the the semicircular ducts not perform this function person will suffer from disequilibrium and fall off balance. And we call it predictive because semicircular duct predicts that dysequilibrium is going to occur (predictive function)

11-how can we fix the image on our retina during head rotation ?

Each time the head is suddenly rotated, signals from the semicircular ducts cause the eyes to rotate in a direction equal and opposite to the rotation of the head.

12-In which condition the neck proprioceptors work?

When the head only is leaned in one direction

13-Give examples of the function of exteroceptors in maintaining equilibrium?

When a person is running and there is air pressure (waves) against the anterior part of the body,

these exteroceptors will send signals that there is a force against oppose the gravity , as response the person will lean forward to oppose this force and maintain the equilibrium .

14-How can the eyes inform about dysequilibrium . and in what conditions it can do it effectively ?

A linear or rotational movement of the body shifts the images on the retina, and this signals the equilibrium centers.

IN what conditions? 1# Eyes are opens 2 #motion are performed slowly

15- give examples for manifestations of vestibular apparatus dysfunction ?

Nystagmus : involuntary rhythmic eye movements (حركة العين متل حركة بندول الساعة)

Vertigo : feeling that the surrounding are spinning. Associated with nausea, vomiting and tinnitus

Motion sickness: nausea,vomiting and spinning

Meniere,s syndrom: attacks of vertigo, tinnitus and deafnes

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